MODELLING INFLATION PROCESSES IN FIJI

Edwin Dewan
Shajehan Hussein
Steven Morling

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Economics Department
Reserve Bank of Fiji
Suva
Fiji

Abstract

This paper develops a single equation model of inflation for Fiji. Inflation processes are characterised by a conventional markup model in which firms operating in an imperfectly competitive market maximise profits by holding a desired markup over input costs, including import prices and labour costs. The results suggest that about three quarters of the long term movement in the general price levels in Fiji has been due to movements in import prices whilst approximately one quarter has been due to movement in domestic factors, in particular increases in unit labour costs. The adjustment of domestic prices to foreign prices is relatively quick. The output gap is important over shorter time horizons.

1.0 Introduction

Like many central banks, the primary monetary policy objective of the Reserve Bank of Fiji is price stability. This focus reflects the broad consensus that has emerged over the past decade that there is no medium term trade-off between inflation and growth. In fact recent cross-country studies, particularly those that include middle and low income countries find a *negative* relationship between growth and inflation in the medium term.[1] That is, inflation impedes an economy from realising its medium term growth potential.

To achieve and maintain low inflation central banks need to understand the nature of inflation processes in their respective countries. This includes the types of shocks that cause inflationary impulses and the nature of propagation mechanisms.

There is broad agreement that, in the longer run, inflation in developing and developed countries is a monetary phenomenon (IMF 1996, p. 114). That is, it is determined by the stance of monetary policy. Of more practical interest, however, are the factors that trigger and sustain inflation in developing countries. As Friedman (1992, p.193) argues "the recognition that a substantial inflation is always and everywhere a monetary phenomenon is only the beginning of an understanding of the cause and cure for inflation."

To date very little research has been done into the causes of inflation in Fiji. Papers by Bandawe (1997) and Morling (1997) provide some

[1] See Ghosh and Phillips (1998).

preliminary analysis. To better understand inflation processes in Fiji, this paper develops an empirical model that helps explain causes of inflation in Fiji, and is also useful for forecasting.

Foreshadowing the results the paper finds that foreign inflation appears to be the dominant influence on inflation in Fiji. Domestic factors, particularly wage costs have a moderate influence. The level of demand has an effect in the short term.

From a monetary policy perspective, the results have three important implications. First, in order to have longer-term price stability, monetary conditions should be consistent with the maintenance of a firm nominal exchange rate. Second, policy should not accommodate excessive increases in domestic labour costs. Third, where possible, monetary policy should aim to align domestic conditions with the productive capacity of the economy.

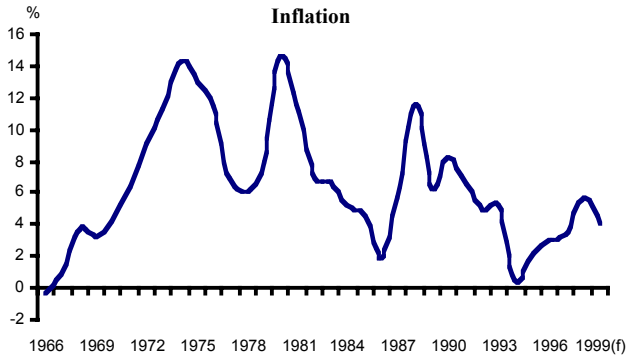
The rest of the paper is structured as follows: Section 2 briefly describes the evolution of inflation in Fiji over the period 1966-1998. Some of the possible factors influencing inflation are also reviewed. Section 3 sets out the conceptual framework of the model. Section 4 presents the empirical results. Section 5 concludes the paper.

2.0 Fiji's Inflation Experience

Inflation in Fiji over the past three decades has been mainly influenced by the nature of exchange rate arrangements and the country's openness. Over the past three decades the evolution of inflation has been notably similar to that in developed countries and some developing countries in the region.

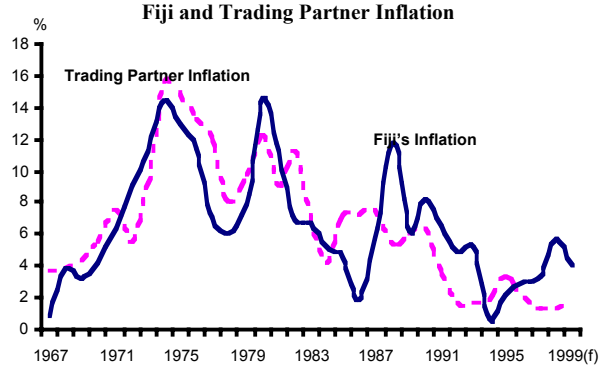
Like most other countries, inflation in Fiji started to rise in the mid-1960s, and accelerated in the mid-to-late 1970s as a result of the oil price shocks, and then declined sharply in the early 1980s (Figure 1). However, unlike many countries during the second half of the 1980s inflation in Fiji rose sharply, largely due to the two large devaluation's in 1987. Inflation resumed its downward path in the early 1990s in concert with most other countries. In 1998, a 20 percent devaluation triggered a sharp temporary increase in inflation, although it fell sharply thereafter.

FIGURE 1
Inflation



With the exception of the exchange rate-related episodes in the late 1980s and 1998, this pattern of inflation closely resembles that documented in North America, Western Europe and major Asian-Pacific economies over that period.[2] The pattern is also consistent with the evolution of Fiji's major trading partners' inflation over the period (Figure 2). Over 5-year periods, the averages are generally close; over the three decades, they are identical.[3]

FIGURE 2
Fiji and Trading Partner Inflation



The close correspondence between domestic and foreign inflation points to the importance of foreign factors (and the role of the pegged exchange rate arrangements) in underpinning Fiji's major inflationary and deflationary episodes.

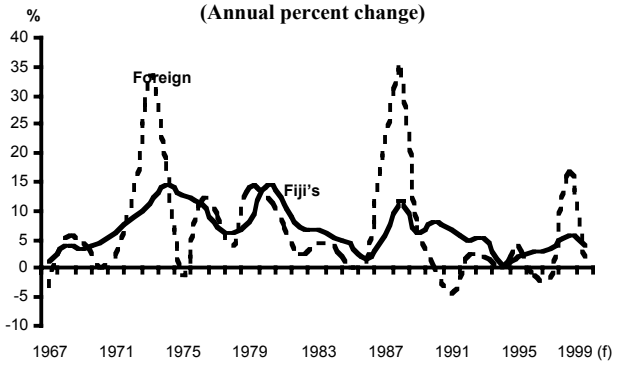
[2] See Parkin (1991), Bomhoff (1991), Fry (1991) and Stevens (1992).
[3] Over the period 1966 to 1998 annual inflation in Fiji and in Fiji's five major trading partners averaged 6.7 percent.

2.1 Foreign Factors

Fiji is a small, open economy and a variety of theoretical models give the result that, for a small country, foreign inflation will be fully imported in the long run under a regime of fixed exchange rates.[4] In effect, a small country with a fixed exchange rate has very little choice but to accommodate foreign shocks to prices. Although the Reserve Bank has open to it a range of tools which may ameliorate the effects of foreign price shocks, the picture in Fiji, as in most other countries with similar institutional structures, is of shocks originating in the balance of payments and impacting through the exchange rate mechanism.

With well over half of Fiji's goods and services imported, there remains a close correspondence between foreign and domestic prices (Figure 3).

FIGURE 3
Import Prices and Domestic Prices
(Annual percent change)

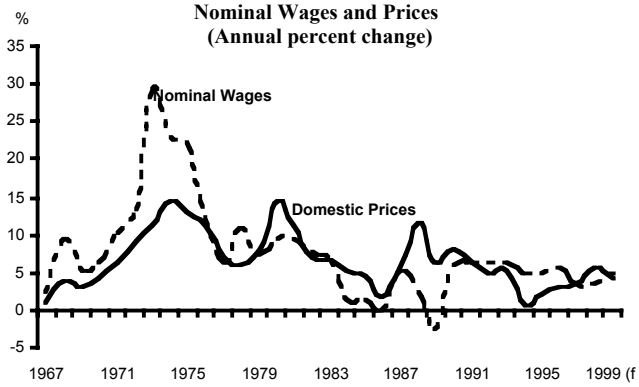


[4] If the country is a price taker in international markets, a rise in world prices will result in a rise in the prices of imports (and exports) which will have an immediate and direct effect on the aggregate price index. There may also be second-round effects where changes in the current (and/or capital) account would lead to an accumulation of foreign assets by the central bank and a corresponding increase in domestic liabilities. The increase in the domestic money stock reinforces the tendency for domestic prices to rise.

2.2 Domestic Factors

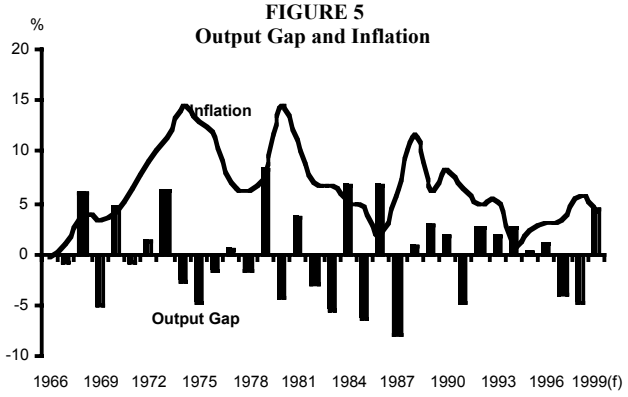
While foreign factors have played a dominant role, domestic factors also appear to have underpinned inflation over much of the period and have been particularly important during key episodes. Nominal wages grew at an average annual rate of over seven percent over the past thirty two years, while productivity growth averaged a little under one percent. The result was sustained growth in nominal unit labour costs which effectively put a floor under domestic inflation (Figure 4). Sharp increases in real wages, particularly during the 1970s and mid-1980s also appear to have intensified price pressures at the time.

FIGURE 4
Nominal Wages and Prices
(Annual percent change)



While broad movements in prices appear to have been largely underpinned by import prices and domestic labour costs, there also appears to have been a correlation with the cyclical pattern of output. Domestic business cycle fluctuations, often reflect a misalignment of demand and the productive capacity of the economy. Excess demand is likely to generate price pressures in factor and product markets. In Fiji, these pressures are partly dissipated through recourse to increased imports, but some pressure on domestic prices is likely. In Figure 5, the output gap - a measure of the amount of slack in the economy - is shown with the rate of inflation. In this case, potential output is calculated by using an exponential smoothing method (Hodrick-Prescott Filter).[5]

FIGURE 5
Output Gap and Inflation



In Section 3 we incorporate these factors into a more formal model of inflation that is amenable to estimation and testing.

[5] Other techniques are equally valid and will provide different measures of capacity.

3.0 A Conceptual Framework

In this paper a mark-up model is used to describe inflation processes. The basic mark-up model has a well-established position in macroeconomic theory (Duesenberry 1950). It is general enough to embody other models and particularly suitable for modelling inflation processes in developing countries.

In a mark-up model, the domestic price level in the long run is modeled as a constant mark-up over costs. Firms price their products by adding a margin to the cost of their inputs. The mark-up is assumed to be constant in the long run, but may vary over the cycle. The costs of production included in the model typically include wages, with import prices often included in open-economy models.

This specification of the cost and pricing structure of firms is particularly suited to developing countries since production is generally labour intensive and a substantial proportion of intermediate inputs are usually imported. Although developing countries are generally price-takers for imported inputs domestic competition is often limited, making an imperfect competition model, such as a mark-up model, an appropriate modeling framework.

The mark-up model used here is specified within an error-correction framework. This approach provides information on long-run relationships as well as short-term dynamics.

deBrouwer and Ericsson (1995) provide a straightforward derivation of a basic mark-up model within an error correction model framework. The derivation below follows their work closely.

The long-run relationship is specified as:

$$P = \theta . W^{\varphi_1} P^{m\varphi_2} \tag{1}$$

where W is the nominal cost of labour per unit of output and P^{m} is the import price in domestic currency. The value θ-1 is the mark-up over costs.

The log-linear form of (1) is:

$$p = \ln\theta + \varphi_1 w + \varphi_2 p^m \tag{2}$$

where lower case letters denote the logarithms of the respective variables.

A generalised autoregressive distributed lag model of (2) takes the form:

$$p_t = \alpha_0 + \sum_{i=1}^{l} \alpha_{1i} p_{t-i} + \sum_{i=0}^{m} \alpha_{2i} w_{t-i} + \sum_{i=0}^{n} \alpha_{3i} p^m_{t-i} + v_t \tag{3}$$

where α is a constant and v is a serially uncorrelated error term.

Equation (3) is modified by allowing the mark-up (θ-1) to vary over the business cycle such that:

$$\ln\theta_t = \ln\theta_0 + \sum_{i=0}^{o} \alpha_{4i} (y - y^*)_{t-i} \tag{4}$$

where y is the logarithm of real output, y^* is the logarithm of trend or potential output, and the difference (y-y^*) is a measure of the output gap.

The intuition behind the variable markup is straightforward. When demand is strong firms may be able to pass on cost increases more easily to consumers; when demand is weak, firms may be forced to absorb cost increases by temporarily accepting lower margins. Accordingly equation (3) becomes:

$$p_t = \alpha_0 + \sum_{i=1}^{l} \alpha_{1i} p_{t-i} + \sum_{i=0}^{m} \alpha_{2i} w_{t-i} + \sum_{i=0}^{n} \alpha_{3i} p^m_{t-i} + \sum_{i=0}^{o} \alpha_{4i} (y - y^*)_{t-i} + v_t \tag{5}$$

Equation (5) can be reparameterised as an unrestricted error correction model by adding and subtracting lags of variables:

$$\Delta p_t = \alpha_0 + \sum_{i=1}^{l} \beta_{1i} \Delta p_{t-i} + \sum_{i=0}^{m} \beta_{2i} \Delta w_{t-i} + \sum_{i=0}^{n} \beta_{3i} \Delta p^m_{t-i} + \sum_{i=0}^{o} \beta_{4i} \Delta (y - y^*)_{t-i} + \beta_5 p_{t-1} + \beta_6 w_{t-1} + \beta_7 p^m_{t-1} + \beta_8 (y - y^*)_{t-1} + v_t \tag{6}$$

Equation (6) is similar to the model used by deBrouwer and Ericsson (1995). It forms the basis for our empirical tests in section 4.

4.0 Empirical Results

4.1 Data

Equation (6) is estimated using annual data over the period 1966-1998. Appendix 1 provides a description of data sources and construction.

Before estimating the model, it is necessary to examine the time-series properties of the data. These are determined using the testing strategy recommended by Perron (1988). Table 1 shows the standard Augmented Dickey-Fuller test (ADF) (Said and Dickey 1984) and the Phillips and Perron (1988) test where a unit root null hypothesis is tested against a stationary alternative. Empirically, each of the original variables (all in logs), except the output gap, appear to be integrated of order 1 or higher. Import prices appear to be I(1) and prices and unit labour costs I(2). However, the estimated roots of the latter series are much smaller than 1. Recognising the weak power of the tests, each series is treated as I(1).

Table 1: *Unit Root Tests*

Variable	Dickey – Fuller Test		Phillips – Perron Test	
	I(1)	I(2)	I(1)	I(2)
Prices	-1.856	-2.497	-1.095	-2.768
Import prices	-1.215	-4.381**	-0.923	- 3.500*
Unit labor cost	-1.290	-2.362	-0.996	- 4.228**
Output gap	-4.550**		-9.724**	

Notes: **(*) denotes significance at the one (five) per cent levels. The critical values for the Augmented Dickey – Fuller tests are –3.658 and –2.960 at the one and five percent levels respectively. The critical values for the Phillips – Perron tests are –3.658 and –2.959 at the one and five percent levels respectively.

4.2 Estimation

The model is estimated over the period 1966 to 1998 as an unrestricted error correction model (ECM). This approach enables the long-run equilibrium relationship and the short-run dynamics to be estimated simultaneously. This approach is recommended over the two-step Engle-Granger procedure, particularly for finite samples, where ignoring dynamics when estimating the long-run parameters can lead to substantial bias.[6]

One of the advantages of this specification is that it isolates the speed of adjustment parameter, β_5, which indicates how quickly the system returns to equilibrium after a random shock. The significance of the error

[6] Banerjee et al. (1993) and Inder (1994) show that substantial biases in static OLS estimates of the cointegration parameters can exist, particularly in finite samples, and the unrestricted error correction models can produce superior estimates of the cointegrating vector.

correction coefficient is also a test for cointegration. Kremers, Ericsson and Dolado (1992) have shown this test to be more powerful than the Dickey-Fuller test applied to the residuals of a static long-run relationship. Another reparameterisation, the Bewley (1979) transformation, isolates the long-run or equilibrium parameters and provides t-statistics on those parameters. Inder (1991) shows these approximately normally distributed t-statistics are less biased than the Phillips-Hansen adjusted t-statistics.

4.3 Diagnostics

Before turning to the results, it is necessary to consider the statistical properties of the model. The model was tested for normality, serial correlation, autoregressive conditional heteroskedasticity, heteroskedasticity, specification error and stability. The results, reported in Table 2, suggest the model is well specified. The diagnostics indicate that the residuals are normally distributed, homoskedastic and serially uncorrelated and the parameters appear to be stable.

Table 2: *Diagnostics*

			Probability
Normality:			
Jarque-Bera statistic	χ^2-statistic	0.144	0.930
Serial Correlation:			
Breusch-Godfrey Serial	F-statistic	0.804	0.461
Correlation LM Test	χ^2-statistic	2.204	0.332
AR Cond. Heteroskedasticity			
ARCH LM Test	F-statistic	0.045	0.833
	χ^2-statistic	0.048	0.826
Heteroskedasticity:			
White Heteroskedasticity Test	F-statistic	1.158	0.386
	χ^2-statistic	15.599	0.338
Stability:			
Chow Breakpoint Test	F-statistics	0.681	0.702
(mid sample)	L-R statistic	9.621	0.294
Chow Forecast Test	F-statistics	0.498	0.852
(1990-1998)	L-R statistic	8.612	0.474
Specification Error:			
Ramsey RESET Test	F-statistics	0.013	0.987
	L-R statistic	0.040	0.981

Notes: **(*) denotes significance at the one (five) per cent levels. No terms were significant at these levels. LR is a likelihood ratio statistic.

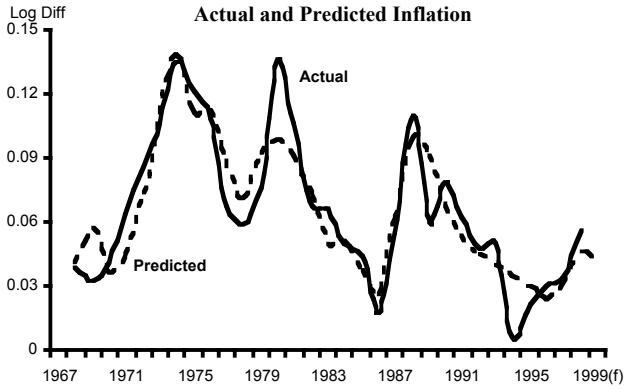
4.4 Results

The results provide strong support for the conventional markup model as a description of inflationary processes in Fiji. They are consistent with the conventional theory, and with the findings of many overseas studies. They are also consistent with our understanding of the institutional structure of the domestic economy.

The results suggest that about three quarters of the long-run movement in prices in Fiji has been underpinned by import prices; about one quarter has been driven by domestic labour costs. The small coefficient on the error correction term points to protracted periods of disequilibrium and long and drawn out adjustment processes, particularly in respect of changes to unit labour costs. In the interim, domestic demand conditions play an important role.

Figure 6 shows that the model fits the data well. The equation standard error is around 0.017 percent, indicating that in about two thirds of the time, the predicted value is within about 1.7 percentage points of the actual value. On 95 percent of occasions, the predicted value will lie within about three percentage points of the true value.

FIGURE 6
Actual and Predicted Inflation



Detailed results are presented in Table 3.

The results show a contemporaneous response of prices to a one percent increase in import prices of 0.21 percent (about one third of the full effect). This is followed by a further 0.09 percent increase in the following year, and then by progressively smaller increments until the full 0.73 percent increase in the general price level occurs[7].

The effect on prices of a one percent increase in unit labour costs is a 0.09 percent increase in the following year and then progressively by smaller increments until the disequilibrium is eliminated with the full 0.20 percent change in the general price level some years later.

[7] In practice, the speed of adjustment may be little quicker than the formal results suggest. Results from a quarterly version of the model suggest that most of the pass through occurs within two years.

During the adjustment phase, the output gap is important. A one percent rise in the change in output gap is associated with a 0.18 percent rise in inflation in the following year. Note, however, that this substantially understates the total impact of the output gap on inflation. Most studies find that the main effect of the output gap on inflation is through input costs, particularly labour costs. If labour costs are removed from equation (6) the estimated coefficient on the output gap term sums to 0.35 (spread evenly over two years).

Table 3: *Determinants of Inflation (Unrestricted ECM)*

Dependent variable: inflation; estimation period 1966 - 1998

Explanatory variables: short run	(1)	(2)
Constant	0.049 (2.120)*	
Δ Prices$_{t-1}$	0.207 (1.637)	
Δ Import prices$_t$	0.205 (10.144)**	
Δ Output gap $_{t-1}$	0.176 (2.660)**	
Δ Unit labor costs $_{t-1}$	0.087 (2.191)*	
Explanatory variables: long run		
Prices $_{t-1}$	-0.165 (-3.782)**	
Import prices $_{t-1}$	0.130	0.732 (13.903)**
Unit labour costs $_{t-1}$	0.022	0.202 (4.411)**
Summary statistics		
Adjusted R^2	0.750	
σ	0.017	

Notes: t-values are in parentheses. **(*) denotes significance at the one(five) per cent levels. For the long-run explanatory variables, the implied long-run coefficients (column 2) were calculated as the ratio of the relevant long-run ECM coefficients to the long-run coefficient on the lagged dependent variable; the Bewley transformation was applied to obtain interpretable t-statistics. The cointegration test proposed by Kremers, Ericsson and Dolado (1992) is employed. σ is the standard error of the equation.

5.0 Conclusions

These results provide useful insights into the behaviour of inflation in Fiji and the role of the Reserve Bank in its determination.

Inflation appears to be driven by both foreign and domestic factors in a manner consistent with conventional theoretical models and our understanding of the institutional structure of Fiji's economy. The results suggest that maintaining low inflation in coming years will depend largely on low inflation in trading partner countries and moderate growth of domestic unit labour costs (and other costs of production).

For its part, the Reserve Bank of Fiji will need to maintain monetary conditions consistent with low inflation and low inflation expectations. In part, this is done through the pegged exchange rate, which acts as a nominal anchor for the economy. With many of our major trading partners now adopting explicit inflation targets (Australia, New Zealand and the UK) and others having implicit commitments to maintain low inflation, it is likely that the growth in foreign currency-denominated import prices will remain moderate in coming years. A firm nominal exchange rate will see these gains transferred directly to a further moderation of domestic prices. Sustainable growth in domestic labour costs (either through moderate wage increases or stronger wage increases underpinned by commensurate productivity increases), supported by appropriately firm monetary policy, would reinforce this outcome.

Appendix: *Data Sources and Construction*

Series	Sources and Construction
Consumer prices	Consumer price index (Base 1990=100). IFS *International Financial Statistics Yearbook* (1998); IFS *International Financial Statistics*, various issues; Bureau of Statistics, *Current Economic Statistics*, various issues.
Unit labour costs	Unit labour costs index *(Base 1990=100)*. Calculated as an index of wages divided by productivity. Productivity data were constructed using real GDP and paid employment. Wages data for 1997-1998 are the mid-points of the range of wage outcomes for year reported by the Fiji Employers' Federation. IFS *International Financial Statistics Yearbook* (1996); IFS *International Financial Statistics*, various issues; Bureau of Statistics, *Current Economic Statistics*, various issues; Reserve Bank of Fiji, *Quarterly Review* (1996).
Import prices	Calculated as an index of export unit values of Fiji's five major trading partners (in $US), weighted by their respective import share, converted into domestic currency at period average official exchange rates[1]. IFS *International Financial Statistics* Yearbook (1998); IFS *International Financial Statistics*, various issues; IFS, *Direction of Trade Statistics*, various issues.
Output gap	Calculated as log real GDP minus trend log GDP (Hodrick – Prescott Filter). IFS *International Financial Statistics* Yearbook (1998); Bureau of Statistics, *Current Economic Statistics*, various issues.

Note[1]: The preferred tariff adjusted import data are unavailable for Fiji.

References

Bandawe, H.P. (1997). Causes of Inflation in Fiji: Experience During 1979-1994, *Working Paper*, Reserve Bank of Fiji.

Banerjee, A., J. Dolado, J.W. Galbraith and D.H. Hendry (1993). Co-integration, Error-Correction, and the Econometric Analysis of Non-Stationary Data, Oxford University Press, Oxford.

Bewley, R.A. (1979). The Direct Estimation of the Equilibrium Response in a Linear Dynamic Model, *Economic Letters*, 3, pp. 357-361.

Bomhoff, E.J. (1991). Inflation in Western Europe, *paper prepared for the Fifth International Conference sponsored by the Institute for Monetary and Economic Studies,* Bank of Japan, October.

Debelle, G. and G. Stevens (1995). Monetary Policy Goals for Inflation in Australia, Reserve Bank of Australia, *Research Discussion Paper No. 9530.*

deBrower, G. and N.R. Ericsson (1995). Modelling Inflation in Australia, Reserve Bank of Australia, *Research Discussion Paper No. 9510.*

Duesenberry, J. (1950). The Mechanics of Inflation, *Review of Economics and Statistics*, 32 (2), pp. 144-9.

Friedman, M. (1992). Money Mischief, Harcourt Brace Jovanovick, New York.

Fry, M.J. (1991). Inflation and Monetary Policy in Pacific Basin Developing Economies, *Price Stabilisation in the 1990s, Domestic and International Policy Requirements*, The MacMillan Press Ltd, Hampshire, United Kingdom.

Ghosh, A. and S. Phillips (1998). Warning: Inflation May Be Harmful to Your Growth, *International Monetary Fund Staff Paper*, 45 (4), pp. 2-5.

International Monetary Fund (1996). *World Economic Outlook, October*, International Monetary Fund, Publication Services.

Kearns, J. (1998). The Distribution and Measurement of Inflation, Reserve Bank of Australia, *Research Discussion Paper No. 9810.*

Kremers, J.J.M., N.R. Ericsson and J.J. Dolado (1992). The Power of Cointegration Tests, *Oxford Bulletin of Economics and Statistics*, 54 (3), pp. 325-348.

Morling, S. (1997). Modelling Inflation in Fiji, *Working Paper,* Reserve Bank of Fiji.

Parkin, M. (1991). Inflation in North America, *paper prepared for the Fifth International Conference sponsored by the Institute for Monetary and Economic Studies*, Bank of Japan, October.

Perron, P. (1988). Trends and Random Walks in Macroeconomic Time Series: Further Evidence from a New Approach, *Journal of Economic Dynamics and Control*, 12, pp. 197-322.

Phillips, P. and P. Perron (1988). Testing for a Unit Root in Time Series Regression, *Biometrika*, 75, pp. 335-346.

Said, S.E. and D.A. Dickey (1984). Testing for Unit Roots in Autoregressive Moving Average Models of Unknown Order, *Biometrika*, 71, pp. 599-607.

Stevens, G. (1992). Inflation and Disinflation in Australia: 1950-91 in *Inflation, Disinflation and Monetary Policy, Proceedings of a Conference*, Reserve Bank of Australia.

Taylor, J.B. (1998). Staggered Prices and Wage Setting in Macroeconomics, NBER*, Working Paper No. 6754.*